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ABSTRACT

This is an environmental education module for integrating topics of water quality in ninth- and tenth-grade social studies classes. The module was pilot tested in Gwinnett County, Georgia in 1975-76. The module sequence is divided into four parts. The first part provides an introductory episode to stimulate student interest in an environmental issue concerning water. The second part is designed to improve understanding of water sources and treatment. The third part develops social studies concepts around examples from the county community. The fourth part has the student apply what he/she has learned to prepare a publicity project. This module is intended to accompany a similar one in ninth- and tenth-grade chemistry classes. (BB)

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WATER

How Good
Is Good
Enough?

ED156485

SE 024 446

Water: How Good Is Good Enough?

Social Studies Module

(9th-10th grade Social Studies)

Pilot Tested in Gwinnett County, Georgia, 1975-1976

Coordinated social studies and science modules developed by ENVIRONMENTAL EDUCATION FOR THE SECONDARY SCHOOLS, A Curriculum Project of the College of Education of the University of Georgia, supported by the U.S. Office of Education under the Environmental Education Act, (Project No. 522AH51215). All rights reserved.

Environmental Education for the Secondary Schools is a curriculum project which developed these instructional materials to help high school students respond intelligently to environmental policy issues. Utilizing local issues to stimulate interdisciplinary thinking and environmental problem solving, the modular materials are coordinated for social studies and natural science classes.

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Hi!

I'm Environmental Eddie.

*I'll be here in Gwinnett County
for a few weeks while you study
local environmental problems.*

*This module is part of an
environmental studies unit you
will be studying in your science
and social studies classes.*

*I hope you'll enjoy it
and learn a lot too!*



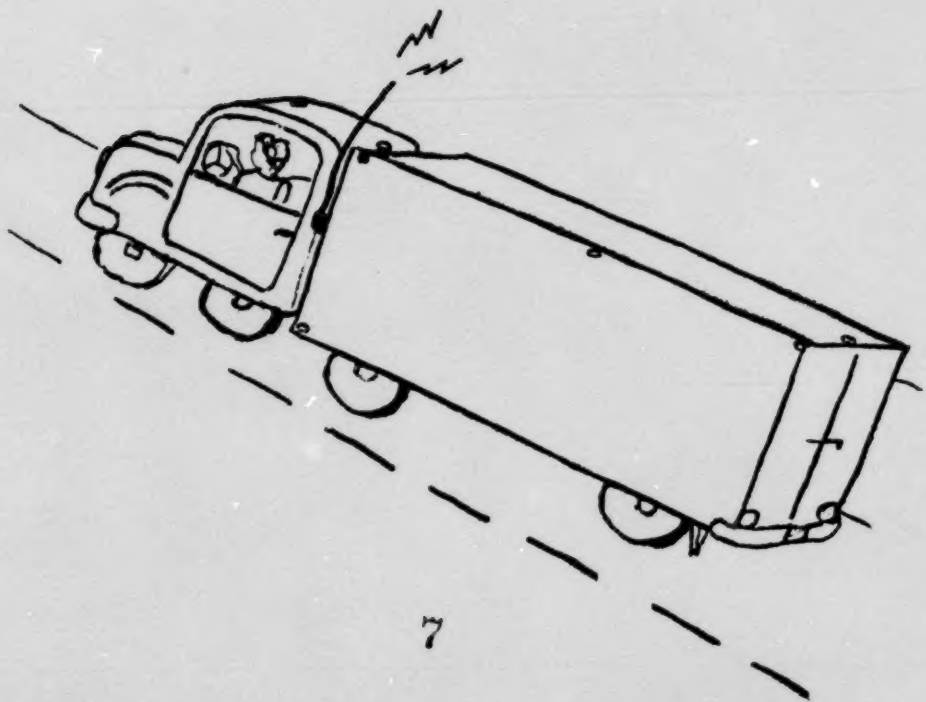
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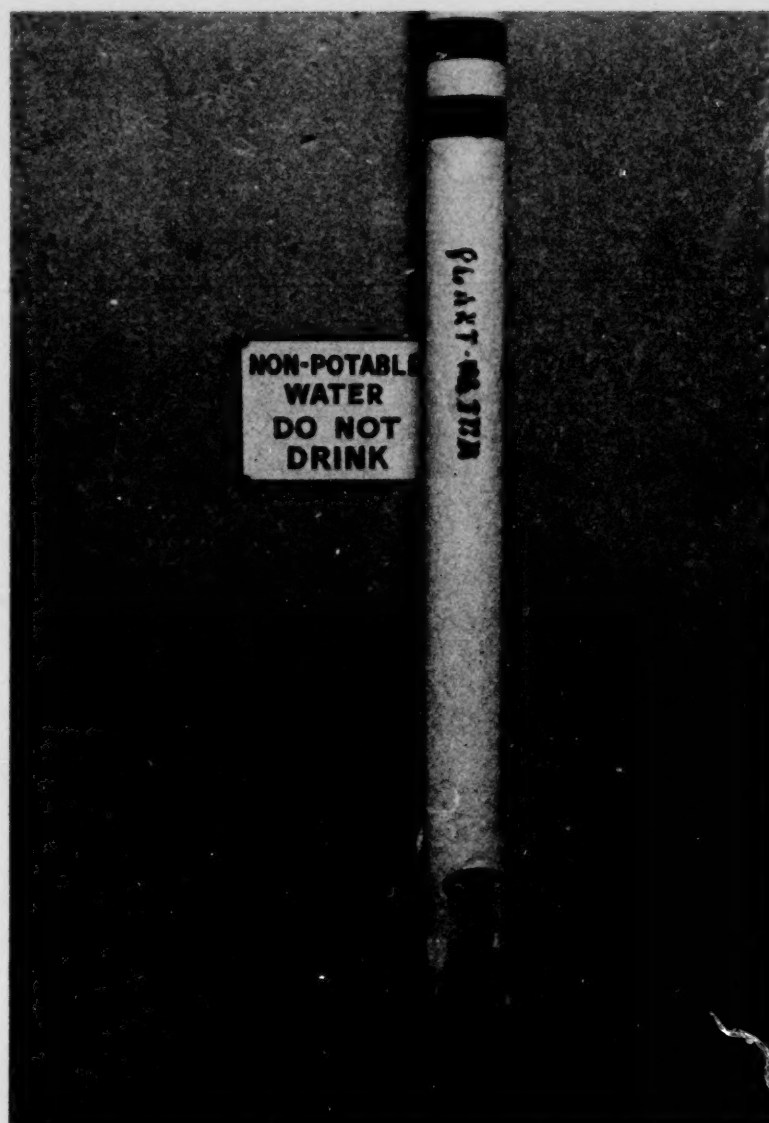
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PART I

WHAT'S THE PROBLEM ?





WHAT'S THE PROBLEM?

Gwinnett Scene: Break for Blue Sunshine

Here is the conversation you just heard:

"Breaker, breaker 1,9."

"Go ahead, break."

"Thanks for the break, good buddy. What's your 10-20?"

"This is the FENDER BENDER truckin' north on 92 highway with a load of chickens. Who've I got on that end?"

"You've got BLUE SUNSHINE on this end south bound and down.

How's it look over your shoulder, guy?"

FENDER BENDER: "Not too good Blue Sunshine, unless you've got your hip boots with you. There's been some bad flooding, down the road about ten miles."

BLUE SUNSHINE: "10-4, on the flooding. What's the trouble?"

FENDER BENDER: "There's a bridge under water at the 121 (one, two, one) mile marker where 92 crosses the Big Sandy Creek. Traffic is backed up so far it looks like a single lane parking lot."

BLUE SUNSHINE: "What did you do, Fender Bender, swim across?"

FENDER BENDER: "That's a negative, Blue Sunshine; I can't swim.

I just left my work '20' (location) on this side of the creek.

I've been hearing about the trouble on this old C.B. radio."

BLUE SUNSHINE: "10-4, there, Fender Bender. Do you live in this area?"

FENDER BENDER: "Yes, I do, good buddy. If I don't have to give too many green stamps to Smokey, I'm planning to build a place near that Buford patch."

BLUE SUNSHINE: "10-4, on the green stamps. What can you tell me about that traffic tie-up? Can I get through?"

FENDER BENDER: "That's a negative guy. The creek is flooded by the gully washer we had last night. There's been trouble at that bridge ever since they started clearing the land upstream from there. Whenever it rains more than two drops, a glob of red muddy water washes downstream."

BLUE SUNSHINE: "Fender Bender, you said you live around these parts, right?"

FENDER BENDER: "10-4, Blue Sunshine, I was raised in an area just south of here. My aunt runs the truck stop down on the Beaver Road exit off I-85."

BLUE SUNSHINE: "10-4, on Betty's Truck Stop. I try to plan my rest stop there when I come this way."

FENDER BENDER: "I guess you won't get that chance today since the bridge is out."

BLUE SUNSHINE: "That brings up another question. I pay gas taxes, road tolls, tire excise taxes and sales taxes from Maine to Florida. I try to make my living on these roads. Doggone it, can't the highway department around here build a bridge high enough to go over that creek?"

FENDER BENDER: "10-4 on the taxes. I know what you mean there, good buddy. I don't know the answer to your questions. I can get you around that mess, though."

BLUE SUNSHINE: "I didn't mean to take it out on you, guy. It's just that I'm losing time and money having to go around the trouble."

FENDER BENDER: "10-4, Blue Sunshine. When you get to Jerry's Service Center, take a left. Go until that road runs out and into highway 87. After about 5 miles or so you should start seeing signs to get you back on highway 92."

BLUE SUNSHINE: "Thanks for the helpful information. Truck'em on easy, Fender Bender. Maybe I'll catch you on the flip-flop at Betty's, if it doesn't rain. This is Blue Sunshine - KCV 1043 - trucking on down to that Atlanta town."

FENDER BENDER: "10-4, on no rain, good buddy. Have a good day today and a better day tomorrow. This is Fender Bender - KJP 4941 - on the side and listening."

Questions for Discussion

1. What did Blue Sunshine want to know?
2. What seemed to be the problem?
3. Why do you think Blue Sunshine was mad?
4. Who did Blue Sunshine blame for the problem? Was he right?
5. What probably caused that creek water to be red and muddy?

Important Vocabulary

silt
erosion
flood plain
ecology
environment

adequate
demand
supply
quality
quantity

Review

I. Match these terms with a related definition before you hear the taped CB conversation.

- | | |
|--------------------|------------------------------------|
| _____ gully washer | A) overflowing of water |
| _____ flooding | B) heavy rains |
| _____ erosion | C) washing away of top soil |
| _____ taxes | D) money paid for speeding tickets |
| _____ green stamps | E) money paid to government |

II. Select the best answer by placing the letter only in the blank on the left:

- _____ 1. What do Fender Bender and Blue Sunshine do for a living?
- A) bridge engineers C) CB radio salesmen
B) truckers D) poultry farmers
- _____ 2. What caused the traffic tie-up?
- A) A bridge is flooded.
B) A car ran into the bridge.
C) The highway department is building a higher bridge.
- _____ 3. What does the traffic problem mean to Blue Sunshine?
- A) Nothing because he is going in the opposite direction.
B) He will have to wait in the stalled traffic until the trouble is cleared up.
C) He will lose time having to go around the trouble.
- _____ 4. The term erosion refers to
- A) the rusting of the bridge supports
B) the washing or wearing away of top soil
C) the filling of the stream bed with soil
- _____ 5. What do you suppose contributed to causing the problem?
- A) Heavy rains caused the stream to overflow.
B) The rains washed mud down from the cleared land.
C) Mud and silt in the stream bed caused the water to flow over the bridge.
D) All the above are possible causes.

What It's All About

This story is based on a situation that actually existed in Gwinnett County several years ago. Mr. Lloyd Harris of the Resource Conservation and Development Office (RC&D) in Lawrenceville explained that the silt filled in the creek bed raising the water level. *Silt* is the mud that settles to the bottom of a creek, when the heavy rains raise the creek level even higher, the water floods over the bridge. The main cause of siltation is *erosion* of the soil at construction sites. Construction on the flood plain(which was not illegal in the county then) causes much more of a problem than non-flood-plain erosion. The *flood plain* is the area that is under water when the creek overflows its banks. Mr. Harris said that the school buses could not get through after a heavy rain. Mr. Harris and his agency helped plan a flood-retarding dam on that creek to prevent that kind of flooding. Now the school buses and trucks and other forms of transportation can use the highway.

The rain can't be stopped. And the rain is necessary to water the forests and agricultural crops and to replenish the ground water supply and the lake level. The roads are needed. The best thing that can be done is for man to understand the *ecology* of his *environment* well enough to plan with the natural forces.

For the next couple weeks, you will be studying water. The information that is presented will introduce and explore the complex relationships between man and water. The facts, the stories, the exercises, the maps and charts included in this booklet are to be used to talk about and to think about the many ways which we use and reuse (waste sometimes) our water supply.

Gwinnett County is a growing community. It is part of the metropolitan area around Atlanta. More people and more industry are coming into Gwinnett County all the time. A community's growth depends on its supply of water. Wayne Shackelford, Assistant to the County Commission stated:

"... a community rises and falls with what it does about water. You cannot get adequate industry without adequate water. You can't get office and institutional development without adequate water. For some reason, you can get citizens without adequate water. They are trusting souls, I suppose . . . but industry won't come unless there is guaranteed adequacy in volume and pressure. . . ."

Those officials also believe that Gwinnett County has enough water to *supply* its needs. The plans for the near future (to the year 2000) can supply adequate water to meet the predicted *demands*.

Fish Tale

Kelly: "The creek floods down below my property."

Lisa: "That's bad."

Kelly: "No, that's good."

Lisa: "Why do you say that?"

Kelly: "It doesn't flood my pasture."

Lisa: "That's good."

Kelly: "No, that's bad."

Lisa: "Why do you say that?"

Kelly: "It floods the road that I have to use to get to work."

Lisa: "That's bad."

Kelly: "No, that's good."

Lisa: "Why do you say that?"

Kelly: "The Office of Resource Conservation and Development is helping
the county with plans for a flood retarding dam on that creek."

Lisa: "That's good."

Kelly: "No, that's bad."

Lisa: "Why do you say that?"

Kelly: "The dam will cause the creek water to back up and cover my
best pastures with a lake."

Lisa: "That's bad."

Kelly: "No, that's good."

Lisa: "Why do you say that?"

Kelly: "I'll have access to the lake for fishing on my days off."

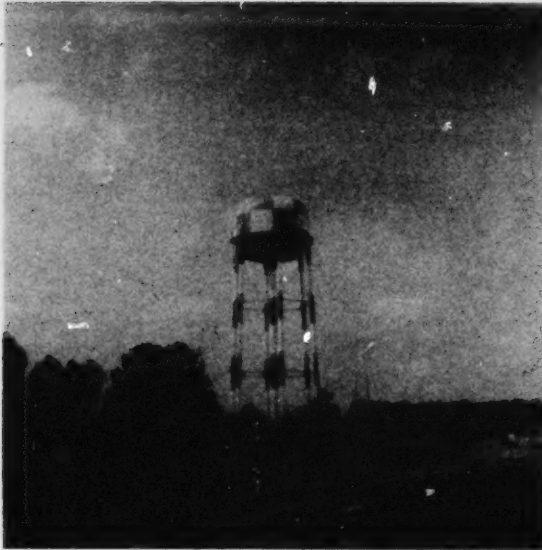
If you overheard this, what would you tell a friend was the topic
of the conversation?



PART II

WATER: WHERE DOES IT COME FROM
AND WHERE DOES IT GO?





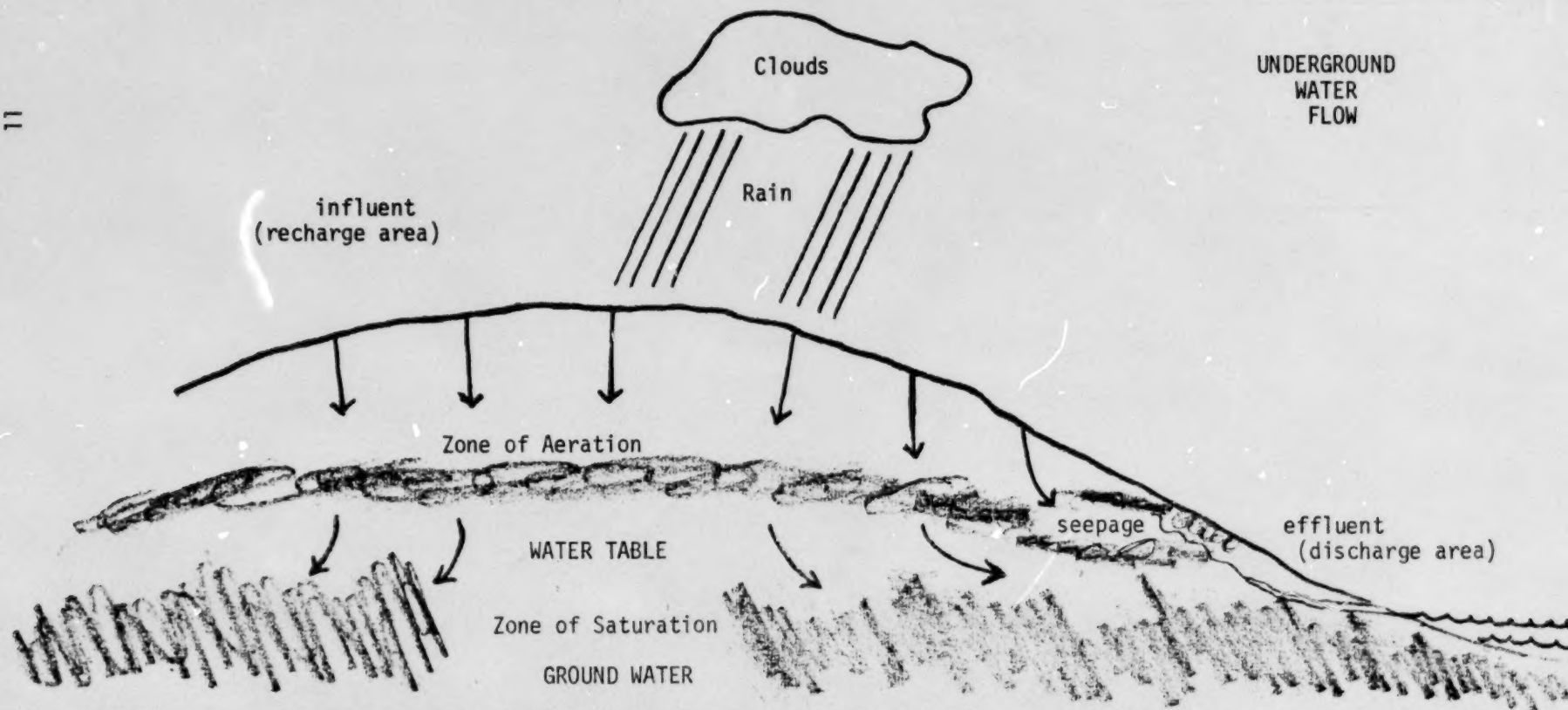
WHERE DOES IT COME FROM?

A simple turn of the water faucet starts a complex process of events. Think for a minute about brushing your teeth or washing your hands. All you had to do to get water was to turn the handle on the faucet. Have you ever stopped to think about where that water comes from? How did it get to your faucet?

The faucet is connected to the pipes under the sink. Those pipes are joined to the ones under the house. The pipes at your house may go under ground to a well or well house. In most cases wells are privately owned. Most wells are dug individually for a farm or a family. The well is a hole bored into the ground. The water is drawn up by the well pump from an underground water source or the water table.

Ground Water

Wells and springs are examples of *ground water sources*. This type of water source comes from the collection of water under ground. After a rain much of the water seeps into the soil and accumulates like an underground river. The water in a creek or a lake also soaks into the surrounding soil. Often a spring at the ground surface is evidence that the water table is close to the surface. Ground water in the water table moves very slowly by the force of gravity from up in the mountains to down to the ocean eventually. Rain water in Gwinnett County may eventually end up in a well in south Georgia somewhere.



The rain recharges the ground surface with moisture. The water percolates through soil and rocks of the zone of aeration and collects in the water table. The zone of saturation is filled with water. The ground water is similar to an underground river that flows very slowly by the forces of gravity down hill.

WATER TABLE

Class Activity



Imagine you are at the local restaurant which is the favorite hang-out for you and your friends. You have come in to the store by yourself, but you know that your friends will be there, too. Before many of your friends get there you order a large coke. You have been playing tennis and are very thirsty for your favorite drink. The waiter brings over a tall, cool glass filled with icy coke.

Would you prefer to be the only one with a straw in that glass? Or would it matter that you had to share it with four of your friends? Why? . . . What difference would it make? Would you have ordered an even larger drink if you had planned to share it? What if one of your not-so-good friends comes over and you feel like you have to share?

If three of your friends weren't very thirsty, would there be any left? If your fourth friend weighs 200 pounds and just got finished playing basketball, would there be any left?

Would you rather pay for the drink by yourself? Or would you rather split the cost 2, 3, 4, or 5 ways? What if one of these 'friends' started blowing bubbles into the drink? What difference would that make? After he stopped blowing bubbles in the drink, how many of you would still continue drinking it? Who would you expect to pay for the whole thing at that point? Why?

Relate the questions in this activity to the way people use the water table. Would it be possible for everyone to tap into the water table with a well?

Surface Water

If the supply of water from the underground water table cannot keep up with the demand of water for homes, for agriculture and for industry, then where will you get the water you need?

If your water supply does not come from your private well or spring, perhaps the pipes under your house lead to bigger pipes that connect into the main water lines under the street. Most of the population of Gwinnett County is on a public water system which is operated by *municipalities* (cities) or by the county government. The water supply system is supported with tax money paid by the people to their city or county government.

Of the cities in the county operating their own water system, most of these buy water from the county. They then sell it to its residents and maintain the supply network. The network includes storage tanks, water mains, fire hydrants and keeping the pressure on the lines. The elected city officials hold city council meetings which are open to the public to decide on the water rate to be charged to the customers. They also appoint an official to be in charge of sending out the bills and collecting the money.

Sources of Gwinnett County's Surface Water

The county operates an intake station and a water treatment plant on the Chattahoochee River near Duluth. The Duluth plant furnishes 12 million gallons a day (MGD) when it is at peak capacity. The capacity of a plant is how much water it can supply when it is operating at top performance. A new \$17 million water treatment plant is under construction on the shores of Lake Lanier. This Lanier Water

Park is expected to be completed by June 1977. Its peak capacity will be 16 to 20 million gallons per day. The new plant is expected to handle the county's water needs for the next five years.

Gwinnett County has a unique guarantee for water from Lake Lanier. None of the other metropolitan counties around Atlanta have such an arrangement. In 1956 an agreement was made between Gwinnett County and the United States Army Corps of Engineers which built the Lake Lanier dam. The bill was passed through Congress providing the county with a regulated water supply of a maximum of 10 million gallons per day. In 1973 the Secretary of the Army extended the agreement which increased the maximum amount of water that Gwinnett County could draw out of Lake Lanier to 40 million gallons per day. DeKalb County and others in the metropolitan Atlanta area are negotiating with Gwinnett County in an attempt to share some of that water supply.

In the last class activity, when you studied about the water table, you compared the idea of the amount of the limited amount of coke to the limited quantity of ground water. Read the activity again and this time keep in mind the amount of water that can be taken from the *surface water sources*, the Chattahoochee River or Lake Lanier.

The main intake for the Gwinnett County public water supply is on the Chattahoochee River near Duluth. The river is not a ground water source. It is a surface water source. The surface of the water is visible and exposed to the air. Other surface water sources include farm ponds, lakes, creeks, streams and other rivers.

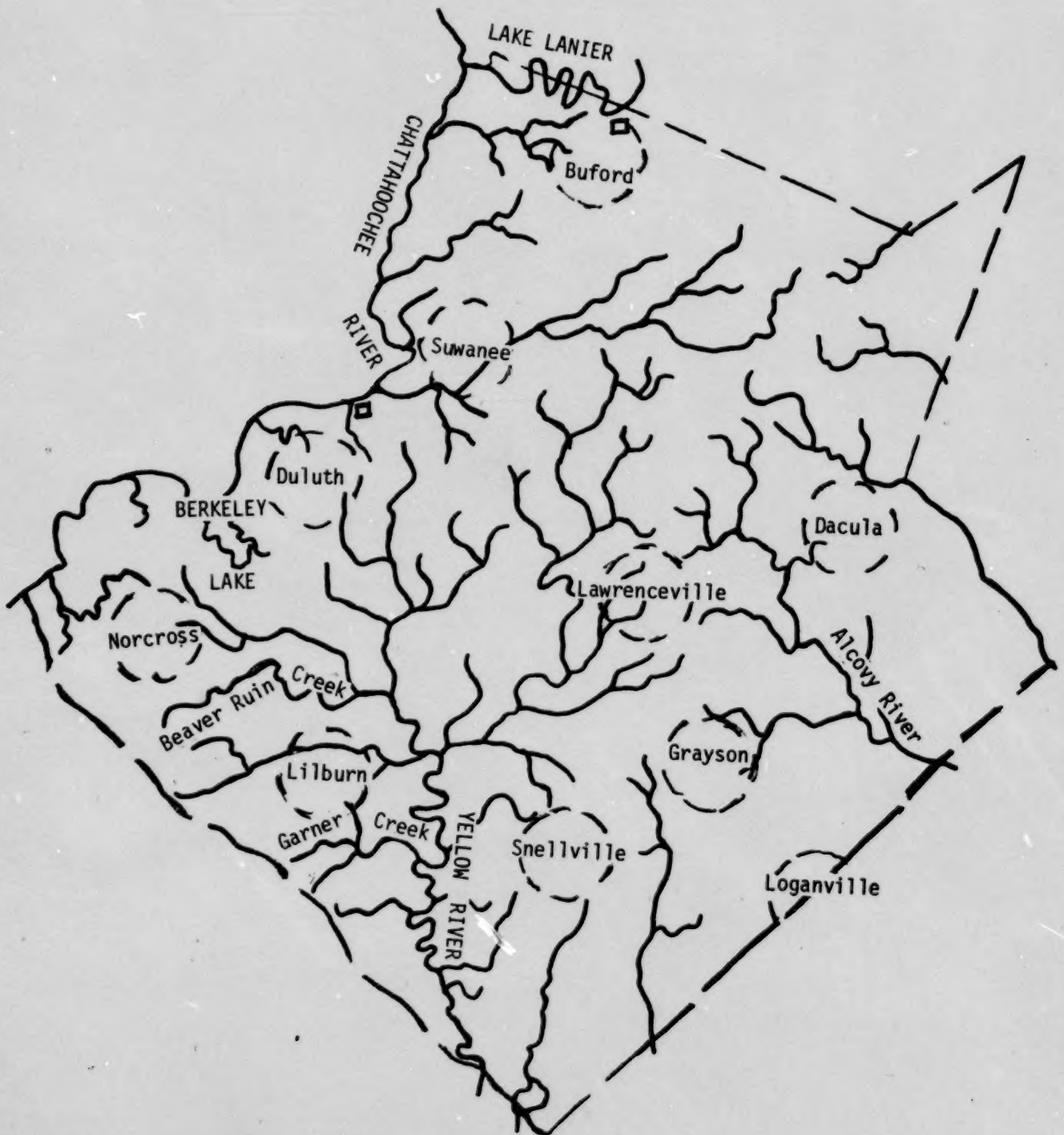
MAPPING SURFACE WATER SOURCES

Class Activity

Using the map on the next page solve the following problems:

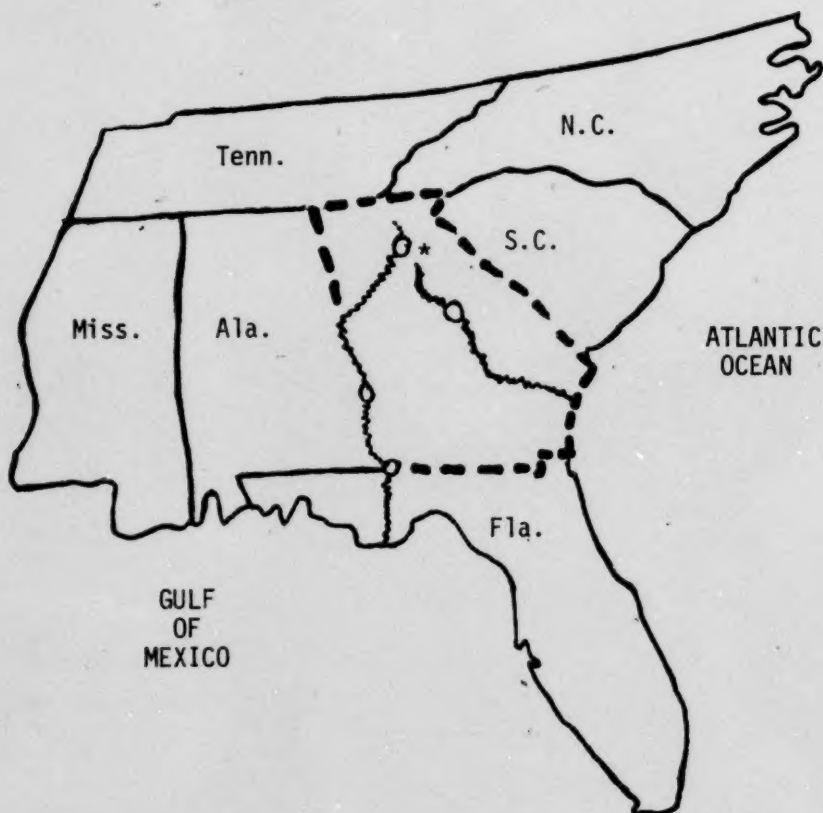
- A. Make a key or color code for the map.
- B. Trace and label:
 - 1. the Chattahoochee River and the Yellow River.
 - 2. the shore of the Gwinnett County portion of Lake Lanier and Berkeley Lake.
 - 3. Garner Creek and Beaver Ruin Creek.
- C. Make a small dark square at the sites of the Duluth water intake and the Lanier Water Park.
- D. Locate where the creeks start which empty into the Yellow River.
Draw a line connecting the starting places (or head waters) of these small creeks around the Yellow River. This outlines the *watershed area* of the Yellow River. A watershed is the area that is drained by a large stream or river. The many small creeks that flow into that river are included in its watershed.
- E. Follow-up Questions
 - 1. Does the water for the Yellow River start inside or outside of Gwinnett County?
 - 2. Where does the Yellow River flow after it leaves Gwinnett County?
 - 3. Does the Chattahoochee River start in Gwinnett County?
 - 4. Does water from any of the creeks in Gwinnett County flow into the Chattahoochee River?
 - 5. Is Beaver Ruin Creek linked to the Yellow River or to the Chattahoochee River?

GWINNETT COUNTY WATERSHEDS



Continental Divide

From the mapping exercise and follow-up questions, you may have discovered that a ridge runs the length of Gwinnett County from south west to north east. A drop of rain can bounce on one side, go into the Yellow River and eventually wind up in the Atlantic Ocean. If that rain bounces the other way, it goes into the Chattahoochee River and down to the Gulf of Mexico. What happens to the quality of water that flows from Gwinnett County has far-reaching effects.



* Whatever happens to the water in Gwinnett County can affect two oceans!! How many *states* could be affected?

PAGES 18-20 REMOVED DUE TO COPYRIGHT RESTRICTIONS.

Review

- _____ 1. Letters to the Editor are typically sent
- A) to book publishers
 - B) to newspapers
 - C) to radio stations
 - D) to television stations
- _____ 2. Which category best describes Ms. Barber's reason for writing her letter?
- A) to offer information
 - B) to praise
 - C) to complain
 - D) to advertise
- _____ 3. Ms. Barber gets her water from
- A) a storage tank in her backyard
 - B) her leaky faucet
 - C) the city water system
 - D) a well in her backyard
- _____ 4. What is Ms. Barber's problem?
- A) She doesn't have any water.
 - B) She can't afford to pay taxes.
 - C) She didn't want to move to Gwinnett County.

The woman who wrote this letter to the local newspaper is clearly upset. To be without water is a serious problem, especially when the water supply is in plain view.

Water is *essential* for life, all life. Man can live for only about five days without water. Water is necessary for drinking, for growing our food, for the trees that supply the boards for our homes, for cleaning ourselves, for transportation and for recreation.

Rainfall on earth remains fairly constant, but our population continues to grow. Every eight seconds a new American is born. The same amount of fresh water must serve the needs of more and more people. The average American uses four times more water in the home now than he did in 1900. Agriculture uses seven times more water now than in 1900. Industry uses eleven times as much as in 1900. In another generation, we will approach the limits of our usable water supply in the United States!

Americans use an average of 50 to 70 gallons of water per day per person just for home use. Modern technology has made water convenient. Most Americans merely turn on the water at a faucet. One study showed that city (urban) families with indoor plumbing used six times as much water as farm (rural) families with outside wells. Why do you suppose that would be so?

While water is essential for life, water is also used in non-essential ways. Non-essential uses contribute to the quality of life that is enjoyed in our society.

WATER CHOICES

Class Activity

- A. Make a list of the ways you use water in your daily activities.
Mark with a check the uses you consider essential.

Suppose something has happened to the storage tank that supplies your neighborhood with water. Or if you are on a well suppose that the longest dry spell in history has lowered the supply of water in your well. Look over your list of water uses.

- B. Divide these uses into three categories: 1) essential, 2) very important but not vital to life, and 3) non-essential.
- C. Number the five uses most important to you.
- D. Compare your list with other classmates.



HOW DO WE TEST AND MAINTAIN THE QUALITY OF OUR WATER?

The faucet has no magical powers for pouring out safe water to drink. Just because the water is clear and sparkling is no guarantee. It may contain dissolved minerals, harmful chemicals or disease germs. In pioneer days, it was possible to drink water safely from a surface water source, such as a stream or bubbling spring. Today it would be very rare to find a surface water source that would be so safe. However, even today, a stream can clean itself naturally, if it is not overloaded with dirty wastes. The stream *re-oxygenates* itself or restores the oxygen supply. A swift flowing stream moving through rapids is *purified* by the splashing action over rocks. The natural process of purification goes on day and night all year round. All the water purification systems used in today's society with modern technology are based on the principles of the natural process for cleaning the water.

With most wells, we are still very dependent on the natural process for clean water. Often when a well is bored into the water table the water is pumped straight into the house with no manmade or chemical treatment. County officials estimate that about 85 to 90% of the citizens of Gwinnett are on the county water system. This leaves very few families in the county dependent on ground water sources for drinking and other water needs. Remember, though, in our discussions that the Yellow River watershed starts in Gwinnett County. The ground water in the water table gravitates toward the lower counties in south Georgia. Other counties may depend more on ground water sources than Gwinnett does.

Perhaps you know someone who has well water. An older member of your family may remember drinking water from a well. Ask them how they knew their well water was *potable* (or safe to drink). The following account is one old-timer's instructions for a re-opened well.

"These suggestions work better on a well that was not dug by hand. A machine-bored well has cement casings lining the sides of the well. The sides of the well can't cave in and cover the end of the water pipe with dirt. More than likely the old pipe, and the valves and pump have been stolen or are too old to use if the well has been left unattended for a long time.

You need to kill the bacteria that might be in that water. Maybe some animal fell in there; you don't know (you never can tell). Before you hook up the pipes to the house, pour a gallon jug of Porex or Chlorox Bleach down into the well. The chlorine in it kills the bacteria. (Now, there's bacteria in your septic tank, too; but they work on your sewage so you don't want to kill them. So if your pipes are already all hooked up, you'll have to open the outside faucets when you start to pump the Chlorox back out.)

Let the bleach stand for a few minutes, so it can mix all in the water. Then start pumping for 10 or 15 minutes, so that the treated water goes through the tank and maybe the pipes if they are all hooked up. Let the water stand now over night or at least 8 hours. By that time the bacteria should be killed.

Now pump out the Chlorox water until the water tastes right enough for drinking. Then you are in business."

That old-timer has the right idea, at least. The well water supply should be safe from harmful bacteria. The water should be scientifically tested from time to time.

A water test may be offered by the well pump company. The test is usually a check on the mineral content and not a bacteria count. The well pump company probably also sells water softeners, which can be attached to your tank to remove some of those minerals.

The water should be checked by qualified government inspectors. Various counties handle this in different ways. In one county the sanitarian for the county health department takes a water sample and mails it to the state water lab in Atlanta. He also inspects septic tank plans. In Gwinnett County local water problems are handled through the Water Department or the Water Pollution Control Department. After the lab test is done, the citizen is informed of the results and any improvements that should be made.

Water Treatment Plant

Most of the citizens of Gwinnett County are on the public water works system. This means that the individual depends on the county or the city (municipality) for his water supply and the quality of that supply. The customer pays for the amount of water used at his home or business. The public water supply presently comes from the intake station on the Chattahoochee River. Buford City has its own system out of Lake Lanier. Water at the intake is surface water exposed to many sources of contamination by air, erosion, dumping, etc. Surface water these days should not be assumed to be potable. It may contain bacteria that cause disease. It may contain silt or minerals that discolor the water or give it an unpleasant taste or odor. It cannot be trusted to be safe to drink without going through a cleaning or purifying process.

Water treatment plants follow the same basic process for making surface water potable for the water system customers. The principal operations used in water purification are *sedimentation*, *filtration* and *chlorination*.

Water is pumped from the river into large holding tanks. The heavier materials in the river water called sediment settle to the bottom. Alum is added to the settled water in a process called *flocculation*. Alum (Aluminum sulfate) precipitates more impurities and finer sediment from the water.

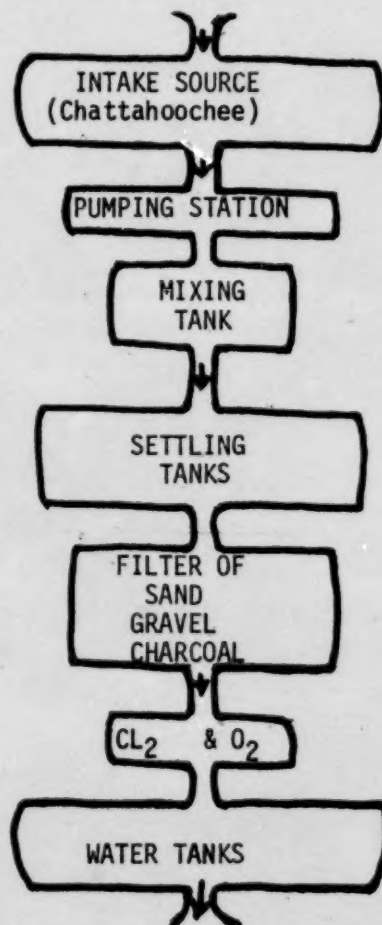
SEDIMENTATION

ALUM ADDED

FILTRATION

CHLORINATION
AERATION

STORAGE



(The alum gathers the smaller particles together until they are heavy enough to sink to the bottom -- much the same way as water vapor collects around particles of dust in the air to form rain drops or precipitation). Next, the water is passed through sand filters or filters with layers of sand, gravel and sometimes charcoal. This process eliminates about 99 percent of the bacteria and whatever small amounts of sediment still remain after flocculation. To be sure that the water is potable, chlorine is added to kill any remaining bacteria.

The purification process may include specialized procedures.

Water may be sprayed into the air to kill the bacteria that cannot live in oxygen. Aeration can be used along with the chlorine. Some communities now add fluorine to help prevent tooth decay. Fluoridation doesn't necessarily make the water safer to drink. (To add fluorine to water is usually a decision made by the voters of the community.) The pH can be adjusted if the water is too acid or alkaline. Minerals that cause the water to be "hard" can be filtered out. Unfavorable colors or odors can be removed. These additional procedures increase costs of the already potable water. However, they do improve the quality of our drinking water.

Hydrologic Cycle

Water is precious to life. It is believed that man could not live much longer than five days without water.

About 90% of our body weight is water.

Water and air may be considered as inexhaustible or

renewable resources. The way that man uses, misuses or reuses the water resource determines how much of that 'inexhaustible' supply is available. The hydrologic cycle is a closed process. Water is not added to the cycle; water changes its physical form and location on the earth by

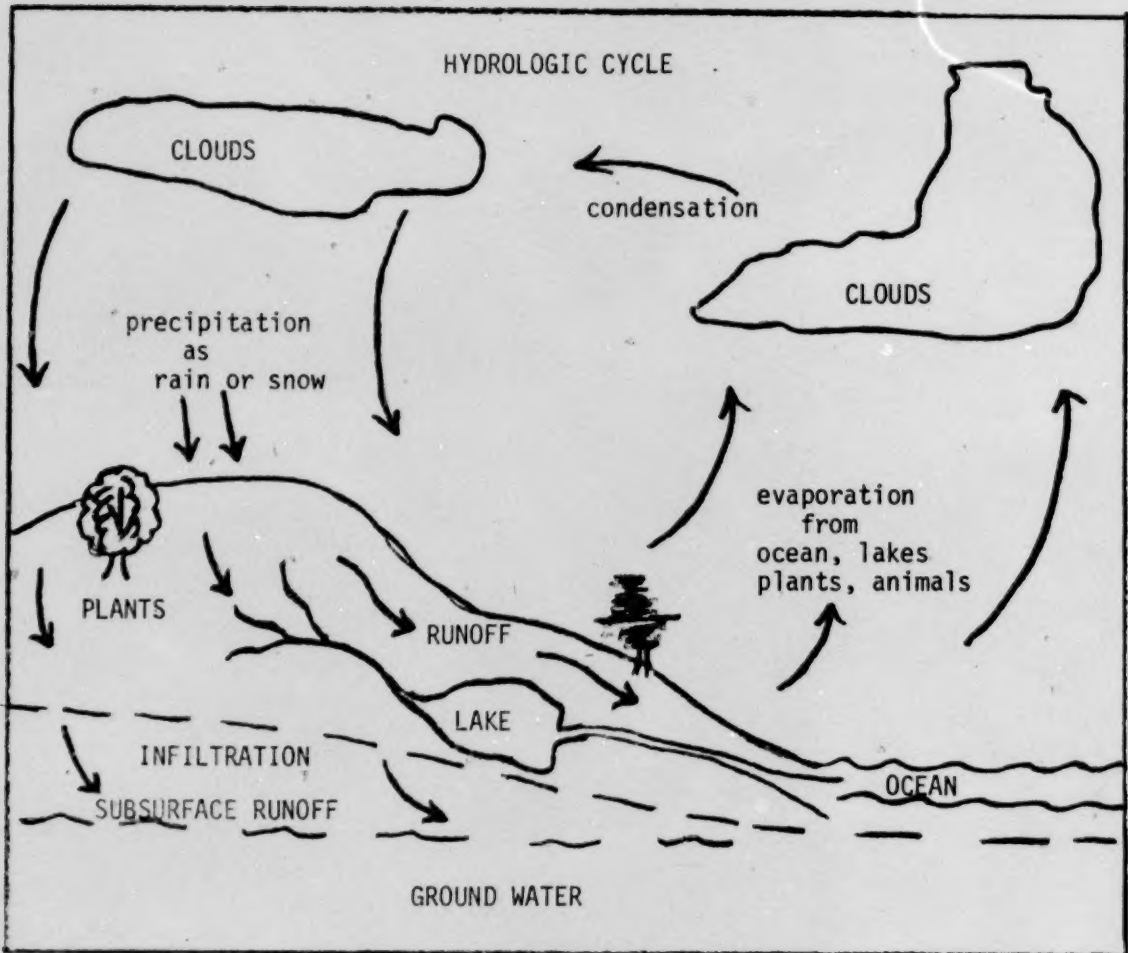


the forces of nature. Arthur Godfrey once wrote, "As ingenious as our technologists have become, they cannot manufacture one grain of soil or one drop of water or one cubic inch of fresh air."

Three-fourth's of the earth's surface is covered with water. Only 1% of all that water is sweet water or fresh water. The rest is in glaciers, ice caps and salt water. Ocean water contains salt and is unfit for human consumption. A passage from the "Rhyme of the Ancient Mariner" describes the sailors adrift at sea dying of thirst in these lines: "Water, water everywhere; nor any drop to drink."

Water is made up of hydrogen and oxygen atoms that combine to form the H_2O molecule. The atoms are here, and as Arthur Godfrey stated, man can't make new ones. Atoms make up our system; nature's system for this world. The Law of Conservation of Matter and Energy states essentially that energy is never created or destroyed; it just changes form. Although it would be impossible to prove, imagine that a molecule of water from a water fountain at might have been one that Betsy Ross, or Benjamin Franklin or Henry Kissinger once drank!!

Nature does its best helping to provide us with water. In the hydrologic cycle, water evaporates from land and ocean. The water vapor rises, is cooled and forms into clouds. Clouds precipitate in the forms of snow, hail or rain. Rainwater that falls on the land surface soaks into the ground or moves over the surface as runoff into streams and lakes. Most groundwater ends up in the ocean, but its trip to the sea is much slower than that of the surface runoff.



1. Trace the steps on this simplified chart of the cycle for a molecule of water to travel full circle?
2. List two ways that rain water finds its way to the sea.
3. List two ways that water vapor rises to form clouds.
4. How would radioactive dust particles travel after they formed into a cloud?



Preview

To help you read and understand, "Gwinnett Scene Bubble of Trouble" answer the following:

- _____ 1. After looking at the sketch on page 31, what kind of trouble do you think that bubble presents?
 - A) It smells bad
 - B) It kills grass
 - C) It looks bad
- _____ 2. A county commissioner is
 - A) A governmental official
 - B) A county policeman
 - C) An engineer in the Water Department
- _____ 3. An assistant is a person who
 - A) assists
 - B) asks
 - C) stands
- _____ 4. A septic tank is designed to handle
 - A) human wastes
 - B) cans, jars and paper garbage
 - C) only organic material from the sink garbage disposal

Gwinnett Scene: Bubble of Trouble

"County Commission office. May I help you?"

"I'm Mrs. Whitehead, and I want to speak to the commissioner."

"I'm sorry Mrs. Whitehead; the commissioner is in his weekly meeting with the county department officials until lunch-time. Would you like to call back after 2:00 pm or leave a message?"

"Yes, have him call me back at 989-9990. Tell

him that my basement is flooded and smells like rotten eggs. It's just awful! I called the contractor but he says it's not his problem."

"You will need to talk to the Administrative Assistant to the County Commission about your problem. He is on another phone right now, would you like to hold on?"

"Yes, I'll wait if it won't take too long."

"Mrs. Whitehead, I'm Ed Norris. What seems to be the problem?"

"Mr. Norris, can you please do something about the mess on my property? My basement smells like rotten eggs and is a big soggy mess. A bubble is swelling up in my back yard. It's been getting bigger and bigger ever since the rain two days ago. I can step up on it, it is so hard, but it squishes around. I don't know what it is."

"Good heavens. I'm not sure what I can do about it. Where do you live, Mrs. Whitehead?"

"I just moved into the new house at the end of Glenwood Way in this new Nancy Creek subdivision."

"Yes, ma'am. I know where you are, and I believe I know what your problem is. I'd like to get some more information from you."

"What is that address?"

"611 Glenwood Way."

"How long have you lived in that house?"

"I've been here 6 months now."

"Are you on a sewer line or a septic tank?"

"I believe I have a septic tank."

"Are your next door neighbors up hill or down hill from you?"

"They are up hill from me on both sides. Even the water from the driveway across the street runs into my yard."

"Mrs. Whitehead, if you will be home tomorrow morning, I'll make arrangements for someone from the Engineering Department and the Water Pollution Control Department to come out and check on that bubble for you."

"Yes, sir. Thank you. I'll be here but I'm staying upstairs because the smell is so bad downstairs."



Review

1. How does Mrs. Whitehead communicate?
 - A) by telephone
 - B) in person
 - C) by letter
 - D) all of the above
2. During this scene Mrs. Whitehead talks to ____ people about her problem.
 - A) 2
 - B) 1
 - C) 3
3. After rereading Mrs. Whitehead's description of the bubble, which definition would you give to the word squishes?
 - A) sloshes
 - B) stinks
 - C) hardens
 - D) squirts
4. At the beginning of this conversation, which word would best describe Mrs. Whitehead's mood?
 - A) bad
 - B) glad
 - C) sad
 - D) mad
5. What would probably have caused her to be in that kind of mood?
 - A) Her basement stinks.
 - B) The commissioner did not solve her problem.
 - C) Mr. Norris would talk to her.
 - D) The contractor would not help her.
6. At the end of this conversation, which word would best describe Mrs. Whitehead's mood?
 - A) glad
 - B) sad
 - C) bad
 - D) mad
7. What would probably have caused her to be in that kind of mood?
 - A) Mr. Norris would talk to her.
 - B) The contractor would not help her.
 - C) Her basement stinks.
 - D) The commissioner did not solve her problem.

Gwinnett County is one of the fastest growing areas in the Metropolitan Atlanta region. The Chamber of Commerce actively but selectively encourages some types of industry to move into the county. These businesses pay taxes and create jobs. Job opportunities draw people into the county; usually faster than their tax money. These people depend on certain services to be provided by the local government (city and/or county). They also expect the government officials to do more in the areas of planning and zoning.

Planning

Many county officials in Gwinnett understand the need and the value of planning for future growth and change for their communities. There have been many classic examples in other parts of the metropolitan Atlanta area of inadequate or no planning. Bill Atkinson, Chairman of Gwinnett County Board of Commissioners and Wayne Shackelford, Administrative Assistant to the Board of Commissioners and other political leaders believe that growth is necessary and inevitable for Gwinnett County. They do hold that insightful planning can be done to avoid problems and to provide the best services for the money to the taxpayers, voters and citizens of the county.

A citizen of Gwinnett County, adds these comment:

"I would sort of view Gwinnett County as a DeKalb County about 15 years ago. . . . DeKalb was fortunate to have one or two very strong political leaders to be able to put in such things as sewer and water systems. . . . The water problem was solved when we were able to have access to Lake Lanier. Developing a sewer system is a serious problem that we still have. . . . We say that we are watching the mistakes made in other urbanizing counties, but we may end up with bigger problems that nobody knows about yet."

Gwinnett County is planning well in many areas. Here are a few examples. A complete soil survey has been made of the county showing soil types and flood plain regions. Some soil types are better suited for development than others. Sandy soil along a creek would not be a good place to build a house and dig a basement. The flood plain region is the area along a creek that is likely to be under water after a heavy rain storm.



ALCOVY WATERS SWIRL INTO WOODS IN SOUTHEAST GWINNETT NEAR FREEMAN'S MILL

Washington Reports Three to Five Inches of Rainfall in Past 24 Hours

In 1975 the county developed the first *flood-hazard* zoning in Georgia. This zoning requirement allows no permanent structure to be built within the 100-year flood plain. The 100-year flood plain zone marks off the area that might get flooded by a very bad storm once in a 100 years. Wayne Shackelford comments, "Our 100-year flood hazard is twice as *stringent* (as the 50-year flood hazard zone along the Chattahoochee River). We are determined that we will not have the problems that Peachtree Creek and Nancy Creek on downstream, where some people didn't understand the forces of water."

Gwinnett was first in the state and about fourth in the nation to enact the soil erosion and sedimentation *ordinance* in 1972. Erosion is one of the major polluters. The soil needs to be stabilized so it won't wash away, especially when the land is being cleared during the construction period. Silt is soil in the water. Silt is harmful to fish. And when it settles to the bottom of the stream or lake, it changes the stream bed or the depth of the lake water. The Simmons Corporation plant is an excellent example of how industry can build within the limits of the law to the benefit of all. The Simmons Corporation was recognized with a national environmental award. The building was constructed without disturbing the natural slope of the land or the natural drainage of the water along the Chattahoochee River. In addition, the cost per square foot compares favorably with traditional construction methods.

Many leaders in Gwinnett believe that these ordinances are very important in preventing problems before a situation becomes a problem. They are also quick to point out that many of the drainage and erosion problems that need to be corrected were caused before these laws were put into effect. Some developers were not aware of the consequences of building a house on a flood plain, for example, until studies were done to support the legislation on soil erosion control.

A question that could be asked at this point might be 'How are these two county laws related to the Bubble of Trouble?' The short answer is that Mrs. Whitehead would not have had the trouble if these laws had been in effect and *enforced* before her house was built. In fact, she probably wouldn't even be living there because the house would never have been built there. A longer explanation reveals more of the relationships involved. The house was built near a swamp which is usually considered as part of a creek's flood plain. The drainage of the water through the soil was poor. A very important factor for a *septic tank* to operate properly is adequate drainage in a soil type that allows water to drain. The soil survey map showing floodplain zones would have been enough to convince an informed and responsible contractor not to build a house in that lot. Now the county laws are based on an understanding of nature. These laws help keep contractors informed, and protect future home buyers from problems like Mrs. Whitehead's.

A Community Problem

Glenn: "I live in a part of the county where I can't hook into a sewer line."

Glenda: "That's bad."

Glenn: "No, that's good."

Glenda: "Why do you say that?"

Glenn: "I don't have to pay the extra tax assessment."

Glenda: "That's good."

Glenn: "No, that's bad."

Glenda: "Why do you say that?"

Glenn: "I have to pay to have a septic tank installed."

Glenda: "That's bad."

Glenn: "No, that's good."

Glenda: "Why do you say that?"

Glenn: "My septic tank drain field won't be in the floodplain of the stream in my backyard."

Glenda: "That's good."

Glenn: "No, that's bad."

Glenda: "Why do you say that?"

Glenn: "That stream is like an open sewer from all the poorly planned septic tanks in the older neighborhoods."

Glenda: "That's bad!"

Glenn: "No, that's good"

Glenda: "Why do you say that?"

Glenn: "That stream runs into the creek that is the main water source for another county and the federal Environmental Protection Agency and the state Environmental Protection Division are requiring that the county government do something about it."

WHAT WE DO WITH WATER

Class Activity

Average Home Use of Water In The U.S. (1967)

<u>use</u>	<u>gallons per day per person</u>
flushing toilet	20.5
bathing	18.5
kitchen	3.0
drinking	2.5
washing clothes	2.0
garden	1.5
washing car	.5
one leaky faucet	12.0

1. What does this chart show?
2. How many of the ways can you use water and still not use as much as one leaky faucet?
3. If it takes about 5 gallons to flush and refill a toilet one time, what comments can you make?
4. Followup Investigation:
 - A. Measure how long it takes to fill up a sink (or a gallon milk jug) with water from a 'leaky' faucet. (You adjust the faucet to 'leak')
 - B. If your family purchases water service from the city or county, check the bill to see what the water rate is.

Used Water

A septic tank like Mrs. Whitehead's is one way to handle human wastes and used water. Waste water comes from all sorts of human activities. Waste water is a category that includes water that is used and is no longer *potable* without treatment. You have already made a list of many of the ways that water is used and wasted in your house. One source states that an American uses an average of 50 gallons a day for personal and home use. When all the water uses are added together and divided by the population of the United States, the amount is nearly 300 gallons per day per person!! This average figure includes agricultural, industrial and residential uses, recreational and navigational uses, mining and urban runoff are practically impossible to measure to include in the average.

Agricultural uses and misuse include irrigation, watering livestock, washing animals and equipment, mixing fertilizers and pesticides, and erosion. Rain can wash chemicals, poisons and soil into nearby streams when plowed fields, or pastures or feed lots are improperly maintained. Industrial uses take many forms; such as mixing orange juice, cooling metals, steam generators, processing paper products. It would be hard to think of an industry that did not use water in some way.

Where do you suppose the rubber from the car tires goes after somebody makes a donut skid mark on the street? What happens to the rain water after it runs off the shopping center parking lot and store roof tops? What happens when the coke can, thrown into the lake, starts to rust? The laundry came out whiter than white, so what?

Did that fertilizer stay on the lawn or get washed away when the sprinkler was left on too long? Are the acids from the paper mill dumped into a stream or sewer line? The key question is: What happens to that water?

Nature Recycles 'Used' Water

Waste water can be treated in a number of ways; however, each of these methods depends basically on the processes found in nature. You learned from your reading that a stream can restore itself by *reoxygenation*. Lake and stream water must contain enough oxygen to support the life of bacteria, algae, plants, fish. A stream can break down a light organic-waste load through *aerobic* bacterial action. But the process of decomposition uses up the water's dissolved oxygen. Bacteria decompose organic materials into the basic elements; such as phosphorous, nitrogen and carbon. These basic elements are nutrients that help algae and plants to grow. As these plants grow they produce oxygen and supply fish with food. As old plants and fish die, the bacteria work to break down the materials into nutrients. They also use up more oxygen. The amount of oxygen that is used up in the process of decomposing waste materials is called the "biochemical oxygen demand" or *BOD*.

The ability of a stream to process wastes depends on several factors: temperature, surface area, turbulence, and the presence or absence of harmful materials. The stream can restore itself or self-purify if it isn't *overloaded* with too much waste material. Fish will

die if the bacteria use up too much oxygen trying to *decompose* so much organic waste in the water. Another type of overload is poisonous chemicals dumped into the stream. These chemicals may kill some or all the organisms that live in the stream environment, which includes bacteria, algae, plants, fish, frogs, water bugs, and ducks.

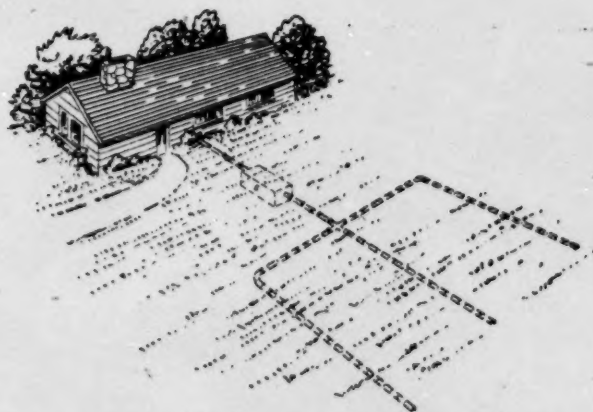
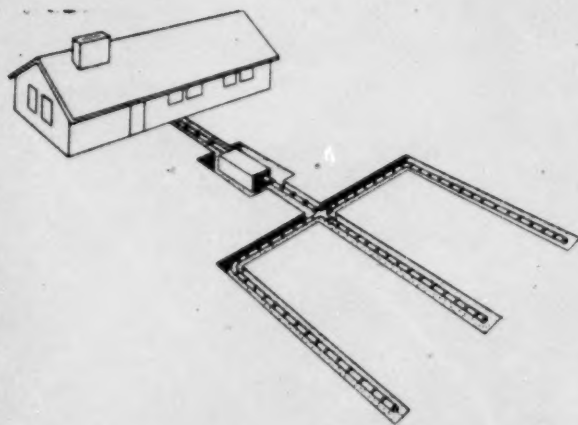
Human or Residential Waste

Waste water can be treated in a number of ways. The simplest way to get rid of dirty water is to pour it directly into a stream or lake. This works so long as the stream is not overloaded with wastes or poisoned with chemicals or choked with oil or silt.



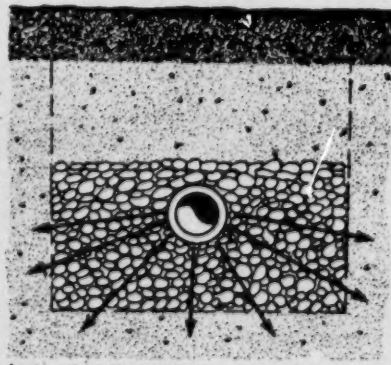
Another simple old way to get rid of sewage was to pour it onto the ground. The outhouse is an example. As more people live closer together and modern technology has devised indoor plumbing, outhouses are out. It is easy to picture the possibility of overloading the natural processes in the ground in a way similar to an overload in the water.

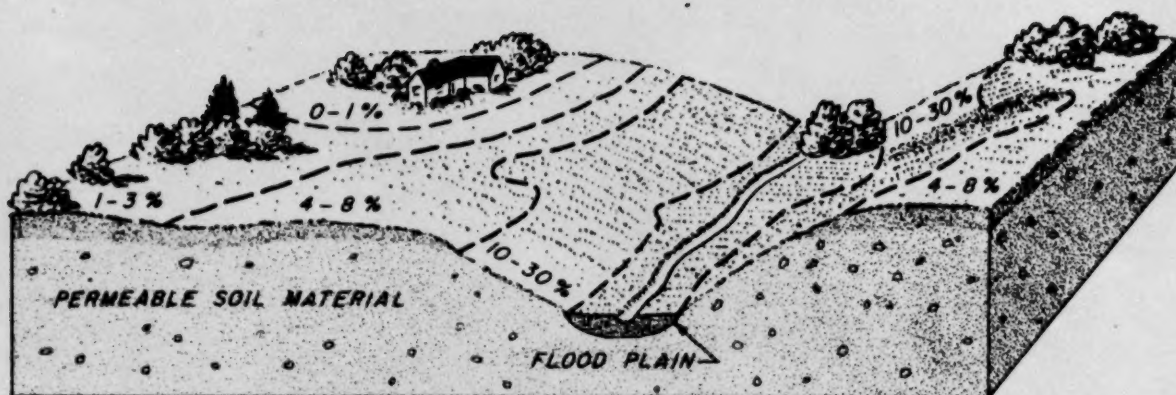
Approximately 90 to 95% of the waste water treatment in Gwinnett County is done through septic tanks. The diagrams on the following page shows the basic plan. Bacteria acts on the wastes. Solid matter settles to the bottom of the tank and the water with some nutrient elements flows through the drain field. The water from the septic tank is called *effluent*. The water (*percolates*) soaks up toward the surface of the ground and evaporates, or is used by plants.



In a conventional septic-tank absorption field, drintile is laid in trenches (above, left). The tank and tile are covered with soil, and the area is planted to grass (above, right). The effluent from the tank is carried through the drintile to all points of the field where it is absorbed and filtered by the surrounding soil (right).

How is percolation related to the diagram of drintile (to the right)?





Septic-tank sewage disposal systems work very well in deep, permeable soils. Layout and construction problems may be encountered on slopes of more than 15 percent. Flood plains are not suitable for absorption fields.

Soil Conservation Service, U.S. Department of Agriculture

The septic tank process works well only under certain conditions. The soil should be loose enough to allow the water to percolate. The



Rock outcrops generally are an indication of a shallow soil, and areas where they occur are not suitable for septic-tank absorption fields. 110-490

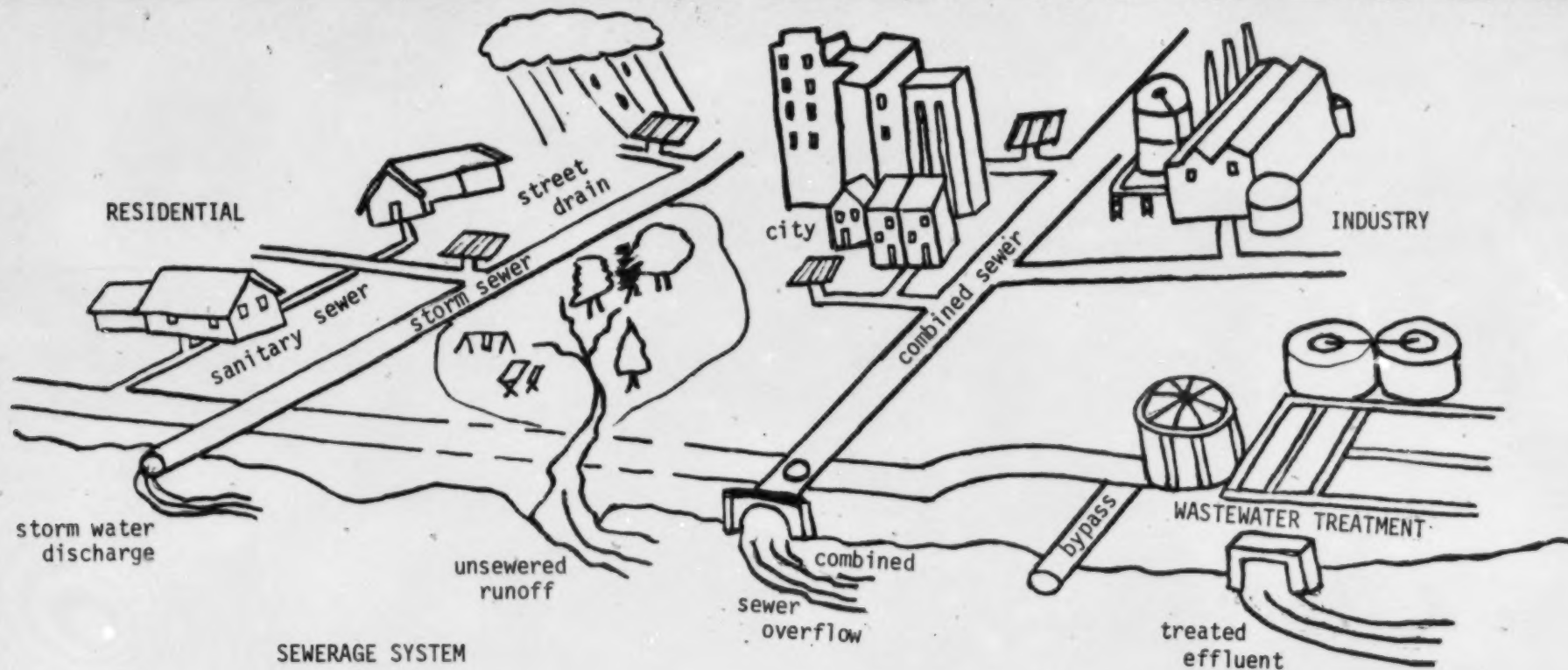
ground-water level should be well below the drain tile. Rock formations should be several feet below the drain tile. The drain field or absorption field should not be on a flood plain or in low lying areas of poor drainage. Many areas of the county do not meet these conditions: the southern end of the county is underlain with bedrock of Stone Mountain, the central portion of the county lies within the watershed of the Yellow River, and the north western edge of the county is along the Chattahoochee River.

Liberty Heights is an area of poor drainage and too many septic tanks. One way to avoid the septic tank problem of the Liberty Heights area might be to set minimum sizes for the lots in new residential areas. The R25 zoning regulation for housing would specify a lot size that could handle an adequate drain field for a septic tank.

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Another way to solve the waste water problem is to follow the plan of the Rockbridge district by planning for the construction of a sewerage system and a waste water treatment plant where the sewage is pumped in through a central system.

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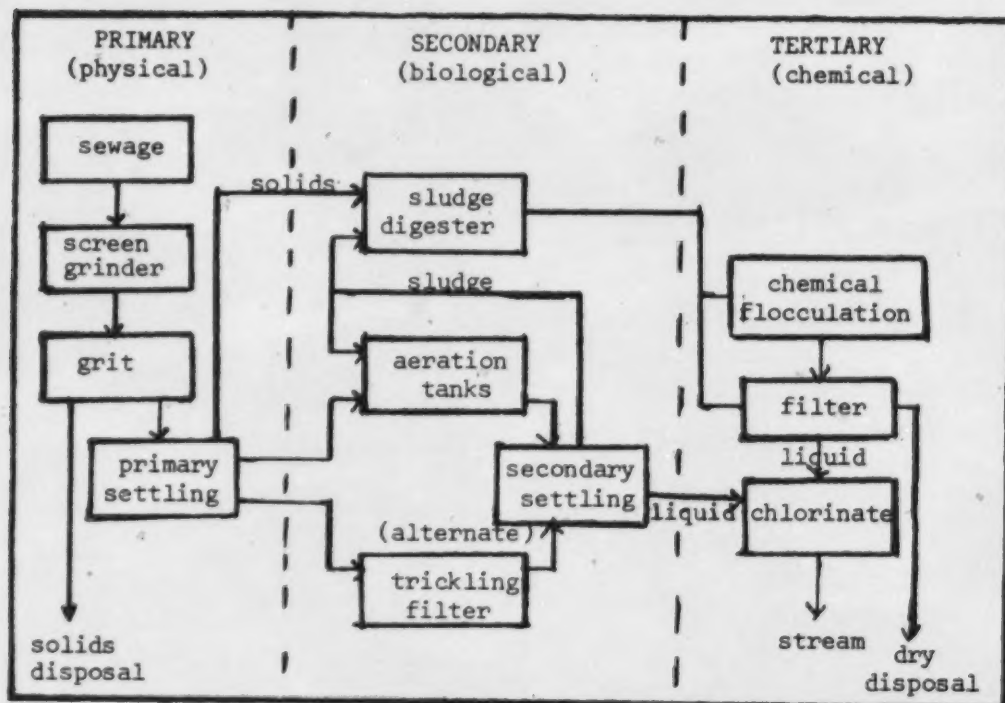
SEWERAGE SYSTEM

The sewage is collected through a *sewerage* system, a system of large pipes which carries the used water (or waste water) to the point of disposal, which is the treatment plant. There are three kinds of sewage:

- a) domestic waste water including human wastes and wash water
- b) industrial waste water such as acids, oils, and animal and vegetable matter (organic wastes) from factories
- c) ground, surface and atmospheric waters (mainly rain) that enter the sewerage system

There are also three basic kinds of sewerage systems:

- 1) sanitary sewers which carry domestic and industrial wastes
- 2) storm sewers, designed to carry off surface and storm waters
- 3) combined sewers, which carry off the sewage through a single system of sewers.



The Process at a Waste Water Treatment Plant

Sewage treatment practices usually fall into three categories:

1) *primary* treatment, which removes the larger bits of suspended and floating solids; 2) *secondary* treatment, designed to provide a way to supply the oxygen demanded by the bacteria (reducing BOD), and 3) final or *tertiary* treatment, which involves chlorination of the liquid effluent and disposal of the remaining solids.

As shown in the figure above the major steps in sewage treatment involves physical (*sedimentation*), biological (*aeration*), and chemical (*chlorination*) processes. How can you compare and contrast the basic processes of water treatment with waste water treatment?

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Words You Should Know

ground water

surface water

water table

watershed

aerate

pollution

potable

hydrologic cycle

flocculation

precipitation

filtration

sedimentation

evaporation

condensation

drainage

commissioner

flood-hazard zone

B. O. D.

effluent

sewerage

septic tank

municipality

metropolitan

essential

non-essential

overload

contaminate

dependent

impurity

purify

chlorine

filter

sediment

evaporate

condense

oxygenate

inevitable

avoid

enforce

stringent

ordinance



PART III

THE PEOPLE:

WHO DECIDES AND WHO IS RESPONSIBLE?



FROM CONSERVATION TO ECOLOGY

"All definitions of conservation can be summarized as: the predetermined use of a resource which will bring the greatest benefit to mankind now and in the foreseeable future!"

from Frank Byrne Earth and Man

"Unique to the planet earth are the quality and the quantity of the waters it provides for us. We know much about the distribution of water, its quantity, its quality, and the uses we can make of it. We know what steps we must take to conserve water so that there will be enough to meet our demands. We have seen how rapidly pollution removes great quantities of water from the earth's reservoir."

from Arthur Godfrey, "Confessions of
Polluter," Readers Digest

"Ultimately, no matter how well technical people understand each other, the decisions are made by political people. . . . Some of us who have served with local planning commissions or other local agencies frequently find that no matter how good our technical arguments are they do not always sell well with political people. . . . There has to be some kind of education of the political individuals who make the ultimate decisions."

Rosemary Duggin, Planner, H.U.D.

"Ecology is the study of three general types of relationships that occur in nature: 1) relationships among organisms of the same kind; 2) relationships among organisms of different kinds; and 3) relationships between organisms and the nonliving environment."

from Jerry Metillo, Ecology Primer

" . . . only within the relatively recent past, has social pressure been translated into legislative action to bring at least some slow down in the rate at which we are polluting the waters of the earth."

from Frank Byrne Earth and Man

The quotations on the preceding page were selected to highlight some of the stages in the development of our ideas about the environment. The main demand of conservation was that the resource to be used by man be used carefully.

Ecology is the new word these days. *Ecology* is the study of the many relationships among land, air, water, animals, plants and man. We are becoming more aware that man is only a part of the total environment. Many of man's political actions have social and economic consequences. These actions also affect the ecological systems (or eco-systems). Some of the consequences of man's actions are immediate and direct and some of them are indirect and are not realized immediately.

In our studies on water we have explored a few of the problems related to supply, demand, use, misuse and quality of our water. Just by working with information related to water *quantity* and *quality* in Gwinnett County, it is easy to see how complicated issues can get. The problems do not simply have one cause. There are many causes. And the solutions are intricately tied to many natural and man-made factors.

Who determines what is an environmental problem? Who decides what should be done about it? What are the possible solutions? How long will it take? How much will it cost? What can be done to prevent it from happening again? Who is responsible for planning for the future? Who needs to be informed? Who has the power to change things and who is responsible?

Review the selected quotations on the previous page in an attempt to answer the questions.

WHAT IS WASTED?

Class Activity

Gilbert Levin, at a symposium concerning the ecological impact of Water Resource Development presented this idea.

" . . . I'd like to point out here that 'waste water' is a misnomer. Except for the times of Noah and Jamestown, there has been very little waste water. The waste that plagues us is a relatively small quantity of material contained in the water. Water is merely the vehicle we use to carry away the waste. . . . In a typical home, we take a concentrated waste and greatly dilute it in order to transport it to a 'factory,' where almost all the time and effort is spent in re-concentrating it so that it can be treated. The treatment process is primarily a biological one and it will not work effectively . . . at the low concentrations . . . to which the sewage has been diluted merely in order to transport it. So we are in a double ratchet: The use of perfectly good water as a waste vehicle offsets and upsets our waste treatment efforts."

- 1.) Levin seems to believe that on the topic of waste water treatment problems that:
 - a) how we use the water is more of a problem than how we treat wastes.
 - b) how we treat wastes is more of a problem than how we use water
 - c) diluting the wastes helps the biological process of treating it
 - d) all of these
- 2.) What solution might Levin propose for the waste water problem?
 - a) Try to produce less waste
 - b) Try to use less water
 - c) Dilute the wastes
 - d) Slow down industrial production
- 3.) What is wasted?
- 4.) What else can be done about it?

Who Decides?

Eddy: "I have to go pay my city taxes, county taxes, state taxes, federal taxes."

Elaine: "That's bad."

Eddy: "No, that's good."

Elaine: "Why do you say that?"

Eddy: "I get services from the government like police protection, water service, sewage service, schools and interstate highways."

Elaine: "That's good."

Eddy: "No, that's bad."

Elaine: "Why do you say that?"

Eddy: "More people will be attracted to this end of the county for the same services and conveniences."

Elaine: "That's bad!"

Eddy: "No, that's good."

Elaine: "Why do you say that?"

Eddy: "More people bring in more businesses that pay more tax money to the government."

Elaine: "That's good."

Eddy: "No, that's bad."

Elaine: "Why do you say that?"

Eddy: "More special interest groups will put pressure on government to spend the tax money in special ways."

Elaine: "That's bad."

Eddy: "No, that's good."

Elaine: "Why do you say that?"

Eddy: "It means that more people are active in helping to manage the county budget."

(Contd.)

Elaine: "That's good."

Eddy: "No, that's bad."

Elaine: "Why do you say that?"

Eddy: "None of these groups are from around my neighborhood and they can't understand the problems that we have."

Elaine: "That's bad."

Eddy: "No, that's good."

Elaine: "Why do you say that?"

Eddy: "I went to a city council meeting myself to find out how the tax money was budgeted."

Elaine: "That's good."

Eddy: "No, that's bad."

Elaine: "Why do you say that?"

Eddy: "I found out that they plan to dig up our streets to put in sewerage lines."

Elaine: "That's bad."

Eddy: "No, that's good."

Elaine: "Why do you say that?"

Eddy: "I found out that the Federal Government is helping with the cost of constructing the sewer system."

Elaine: "That's good."

Eddy: "No, that's bad."

Elaine: "Why do you say that?"

Eddy: ?

How would you continue this conversation?

Public Protection



Water is essential to life. Safe drinking water is very important to the people in this county, this state, this country and in this world. The public water systems and the public waste water treatment plants provide very valuable services to the people who use them. However the people who use these services are dependent upon the officials who operate these systems. The systems are usually managed by the city or county, but mismanagement could have far-reaching effects beyond the county.

Many levels of governmental agencies are involved -- federal, state and local -- in determining what those quality standards should be and monitoring the quality of water. In theory all elected officials in our representative form of government derive their power of authority from the "people" (the voters). When citizens demand a certain quality of service, officials decide on policies based on the best technical information that is available at the time.

Far too often people can be overheard saying, "They (meaning the government) have raised the standards for quality so high that it will cost too much of my tax money to make the necessary improvements." These standards are improved for the citizen's protection. Under the Federal Environmental Pollution Control Act Amendment of 1972, passed by our elected senators and representatives in Congress, grants can be awarded to state, county or city to provide 75% federal money to match 25% local money. The grant money is planned to fund improvements in waste water treatment. So, "they" are requiring that certain improvements and quality standards be met for "our" benefit.

In Gwinnett County the Water Department maintains the public water system and monitors the private water supplies. The Water Pollution Control Department is in charge of waste water treatment.

In the state of Georgia the Environmental Protection Division (EPD) of the Department of Natural Resources keeps a check on local operations and helps them meet new standards in laws passed by Georgia General Assembly.

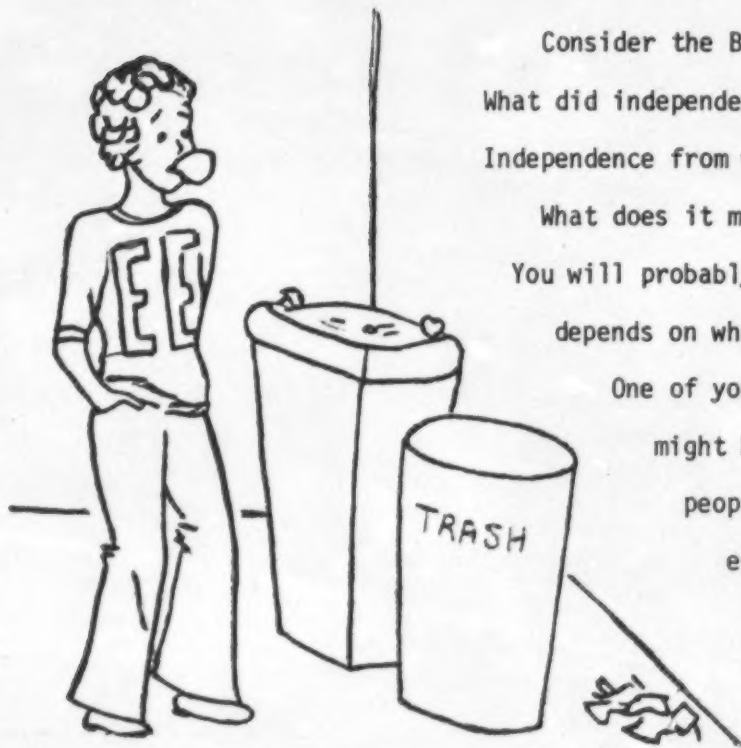
(EPD) of the Department of Natural Resources keeps a check on local operations and helps them meet new standards in laws passed by Georgia General Assembly.

Then at the national (or federal) level the (EPA) Environmental Protection Agency enforces the laws established by Congress and helps the other levels of government meet their responsibilities to comply with the standards set by the law. One way is to grant money to the state and local governments to help them meet new or revised standards.

Other agencies serve as advisors, facilitators and mediators, but they usually have few enforcement powers. The Southeastern Water Lab in Athens is a federal agency that does research, makes reports, will test water samples and will help at the request of the state. The Resource Conservation and Development (RC&D) office in Lawrenceville is a federal advisory agency that helps with local resource management; such as food retarding dams, seeding grass on road banks and planning nature trails. The Atlanta Regional Commission (ARC) is a planning agency which considers planning problems that would affect the Atlanta metropolitan area and help the different factions on an issue to resolve their differences through compromises that would best serve the whole area.

These agencies work together for our benefit, protection and progress. The agencies are created by our elected representatives in the legislatures. And our tax money is used to run these agencies. It is the responsibility of people to understand the issues and the consequences of the decisions before they vote or appear before a city council.

INDEPENDENCE TO INTERDEPENDENCE



Consider the Bicentennial Year.
 What did independence mean in 1776?
 Independence from what to do what?
 What does it matter what you do?
 You will probably agree that it
 depends on what your action is.
 One of your first thoughts
 might be about the other
 people involved. Who
 else will be affected
 by what you do?
 Just your
 friends or

the whole school? It depends on the consequences of your actions.

Here is one simple example. Your chewing gum is getting stale. You could wrap the gum in a piece of paper and throw it in a trash can. You could just throw it down on the hot parking lot without thinking. You could just feel mean enough to stop up the water fountain with it. Getting rid of the chewing gum is a simple action -- no problem.

The problem comes when you see the consequences of what you have done. The janitor would throw it into the dumpster when he cleans up. But if you dropped it in the parking lot, no one could blame you if the same purple gum sticks to someone's shoe and gets on the school carpet. Or if no one is looking, who would think that you stopped up the fountain?

Now suppose that your friend steps on some sticky gum in the parking lot just before he gets into your car. Or suppose that the messed-up water fountain sprays water on your new suede jacket. The same act of throwing away that piece of stale gum takes on a new meaning.

What does it matter what your classmate does? What does it matter what your parents do? What does it matter what a county commissioner does? Most acts will affect you eventually, indirectly. Neither you nor other people are completely independent.

A local citizen makes these observations about Gwinnett County:

"All of us will complain if something is not done, but we won't take the time to write a letter or to attend a (public) forum where the problem is going to be ironed out. There have been a few occasions when there has been good participation, but unless it is a hot issue, public support or public participation is pretty slim. . . ."

He adds this explanation, *"I think most folks elect representatives that they feel will vote and pretty much express their opinions. . . . People respond only after they have been directly affected. If there is a controversy or the neighborhood is overrun with real problems, then you will have participation."*

We are less independent than we first imagined. We are really more interdependent. That is we affect other people and are affected by them in many ways, and some of these ways are not immediately apparent. We depend on each other, and the consequences of our actions affect us all in many ways. The right move or the best decision depends, too, on what we know about a given situation.

WHO DEPENDS ON WHOM FOR WHAT?

Class Activity

Using the information you have learned about water and your understanding of interdependence among people, consider the following situations:

1. Why does Gwinnett County's water supply depend on Lake Lanier?
2. Nancy Creek floods homes after heavy rainfall, but Jackson Creek does not. Can you explain this?
3. Why can't everyone get water from wells? Why are some wells contaminated?
4. Why do sewage treatment plants cost so much money?
5. Why shouldn't everyone in the county have a septic tank?
6. Why does DeKalb County care about how much water is taken out of Lake Lanier?
7. Why is Clayton County concerned with waste water treatment in Gwinnett County?

Divide into small groups so that each group can work on one question.

Write down the thoughts which you have which might contribute to the answer.

Words You Should Know

Environmental Protection Agency (EPA) - federal agency
 Environmental Protection Division (EPD) - state agency
 conservation
 interdependence
 mismanagement
 organism
 responsibility
 reuse

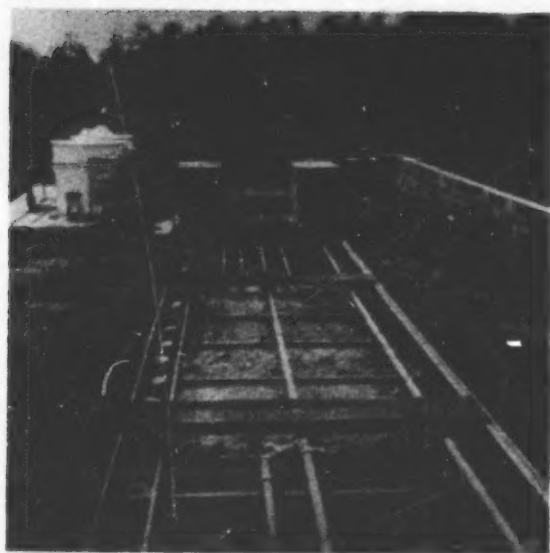
consequence
 alternative
 federal
 political
 resources
 misuse



PART IV

THE INDIVIDUAL:
WHAT CAN YOU DO?





HIDDEN WORDS

L O T R E A T M E N T R A N S P O R T A T I O N
 L D E N T A L R R L I S E W E R A G E S L O W O P
 T A E I E A C U A O A A E E D I R T Y A S K I N G I S
 I C D P U R I F Y S T T P O O L A E V E N S S I T R E
 D I E D L T T W D N E N O D O R E L K T V A O W D A D R
 E T E L F X P A A I T I W F L O C C U L A T I O N N L U
 N I N E F F E R E Y S A N K F O R M E L S N O R E I E T
 I L E I E D S T R E A M N E L U E W E E A N G P A I A
 B O P Y C O E N O S W I M N O D O R O W E C O L O G Y R
 M P O T A B L E M N R N O O D S U N S R I P E D I E
 O T R I P D A M U D E R N O O C L E P O T T N T A X E S P
 C O U N T Y T I L I P T V R O A R E E I A E A I R R A M
 I O W U E V I D A T O O C E A N A R E N M R P R I V A T E
 T S O M L E V E L E N P A G E W O T T G L O A N I E S I A
 S U R M I L E S E L E N P A G E W O T T G L O A N I E S I A
 E O G O O D E L E L E N P A G E W O T T G L O A N I E S I A
 M R Y C T D T L I N E N T A L D U T O X Y G E N T E S T
 O E T M A P A I A N E R A T E L A R O O F C N A U S I
 D N R O G E R M H A N E R A T E L A R O O F C N A U S I
 N O I T R E E N G H A N E R A T E L A R O O F C N A U S I
 A I D A M O V E N G H A N E R A T E L A R O O F C N A U S I
 M T R E E S I V O N W A F E R D A O A I O U O V A A E
 E A C H L O R I N A T S O M U D C C E T D P U M P L E I A O
 D C I T S O D G E B A C T E R I A C C S N E L N C U T T R R
 P U S U L Z O N I N G A R S O R I A O U N I O I D L A U D
 E D A C I D S O U N D W A U S T O B U R L O O D P L A I N T N
 E B B A S E M E N T E T O S U U G A I N U R B A N A
 A I R E L A T I O N S H I P S N O W E E P A S T

Review What You Have Learned

- A. Find the words that are related to your studies about water and the environment. Circle the letters that form the words. Each letter can possibly be used to form some kind of word. Some letters can be used in more than one word.
- B. After you circle the word, write it down and define as many as you can.

WHAT DO YOU THINK?



Write your own story

or cartoon lines
or article
or anything

65

Putting It Together

Class Activity

A Visual Challenge

A set of slides of scenes from Gwinnett County and neighboring areas offer examples of the topics you have been studying about water problems. As you view these slides try to relate the scenes to what you have learned.

Think about these four "laws" of ecology:

1. Everything is connected to everything else.
2. Everything must go somewhere.
3. Nature knows best.
4. There is no such thing as a free lunch.

On a sheet of notebook paper page number down the side of the page for the slides. As each slide appears put down the number of the 'law' that best fits what you see in the picture. No slide will have just one correct subtitle. We learn different ideas in different ways, so we may interpret what we see differently. Your choice of a 'law' is not as important as your reasons for choosing a particular law. Be ready to share your opinion with the class if you are called on.

Pre - View Comes Before the View

A field trip has been planned to tour the Jackson Creek Waste Water Treatment Plant. The Jackson Creek Plant is one of the newest and largest waste water treatment plants in Gwinnett County. The plant is located near Lilburn. The plant can treat 2 million gallons of sewage per day. Jackson Creek is one of 5 Sewer Drainage Areas of Gwinnett County. It will handle a 6,500 acre area as more homes are connected to the county sewerage systems. You will preview some slides of the plant before you go. Turn to page 48 in Part II that shows the diagram of the waste water treatment process. The slides will show examples of the stages in the treatment process.

Suppose you are a news reporter. You have been selected as one of a special group to tour the plant at its grand opening. After re-reading the section on waste water and previewing pictures of Jackson Creek Plant, what kinds of questions would you ask the guide? Be thinking about the questions you would need to ask. You could describe the plant to the people who will read or hear your news report. You could do a personal feature about the director of the plant. Or you could explain what the new plant will mean to the homeowners of the area.

GETTING DOWN TO ACTION

Every person who drinks water should know as much or more about water as you do. They should understand where their water comes from and where the water goes. Every person who turns on the faucet and trusts that the water is potable should know what is involved. They should understand who makes the decisions and who is responsible for the quantity and the quality of the water they drink.

Reading the newspapers and talking to the public officials are two very good ways to keep informed. Voting and attending meetings are ways to contribute to the decision-making process. Becoming more aware of the ways our resources, especially water and air, are used and misused helps the individual to make wiser choices. The individual learns to understand some of the consequences of his misuse of resources. He or she learns that the study of ecology helps him understand man's interdependence with his environment.

Now that you have learned something about the resources and environment of Gwinnett County how can you inform others? How can you make other Gwinnett people more ecologically aware? How can you help others learn what you have learned about the use and the misuse and the reuse of water?

One way is to plan a poster campaign to get your environmental message across to others. Design some publicity with pictures, words and diagrams. Perhaps you will want to design an environmental campaign poster. Or a collage. Or maybe a slogan for a bumper sticker.

Perhaps your posters and collages can be displayed in the school for other students to see. Perhaps your posters could be displayed in store-front windows. A local newspaper may wish to write up your communications campaign. You can create a lot of interest in the protection of water resources and in the water problems of the Gwinnett community. All sorts of things are possible. Start planning and get down to action.